TITLE

AEROSOL CEMENT AND VALVE FOR DISPENSING SAME

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application is a continuation of Ser. No. 09/905,373, filed 7/16/2001, which is a continuation-in-part of Ser. No. 09/347,787, filed 7/6/99, now abandoned, which is a continuation-in-part of Ser. No. 08/920,600, filed 8/28/97, now abandoned. This application is also a continuation-in-part of Ser. No. 10/168,121, filed 6/17/2002, which relies on the filing date of PCT application Ser. No. PCT/US00/26276, filed 10/26/2000.

STATEMENT REGARDING FEDERALLY SPONSORED RESEARCH OR DEVELOPMENT

(Not applicable)

REFERENCE TO SEQUENTIAL LISTING, A TABLE, OR A COMPUTER PROGRAM LISTING APPENDIX SUBMITTED ON A COMPACT DISS

(Not applicable)

BACKGROUND OF THE INVENTION

1. Field *of* the invention

[0002] This invention is directed to an aerosol solvent weld cement composition, a dispensing system including an omnidirectional female valve for dispensing the composition, and a method of joining pipe using the composition.

2. Description of the related art

[0003] Plastic pipe has become increasingly used in a wide variety of applications, such as in water transmission networks, residential plumbing, and in the

construction of a wide variety of structures having no relation to water transmission. Plastic pipe continues to replace ceramic and metal pipe in a variety of applications owing to its reduced weight, lower cost, and resistance to cracking under stress. Suitable plastics commonly used for pipes are chloropolyvinylchloride, known as CPVC, polyvinylchloride, known as PVC, or poly(acrylonitrile-butadiene-styrene), known as ABS. Of these, the PVC is the most common.

[0004] It is known in the art to join sections of plastic piping together in the formation of an elongated plastic pipe. Solvent weld cement has been used as a bonding agent in the joining of sections of plastic pipe. This agent softens the plastic surfaces to which it is applied and, when the surfaces harden, they are chemically bound together.

[0005] U.S. Pat. No. 5,336,351, issued to Meyers, discloses the use of solvent weld glue (or cement) to join pieces of plastic pipe. In this disclosure, a male end of a first section of plastic pipe is fitted with a flexible pipe connector made of low density polyethylene to form multiple receiving means on the outer surface. Solvent weld cement is applied to the receiving means and the thus-treated male end is inserted into the female end of a second section of plastic pipe. This method requires additional material, thus adding to the expense of construction. Also, if the work is being performed in confined areas, the attachment of the flexible pipe connector to the male end of the pipe would add frustration and labor costs to the procedure. The Meyers disclosure does not reveal the composition of the solvent weld cement or the method of application of the solvent weld cement to the flexible pipe connector.

[0006] King, Sr., in U.S. Pat. No. 4,687,798, reveals the use of a solvent weld cement wherein the improvement is an added ingredient in the solvent. The solvent weld

cement is useful for the purpose of joining pieces of PVC. The use of solvent weld cements in the joining of plastic pipes is mentioned in this patent. The compositions of the King, Sr. formulation are stored and used in liquid form. The conventional method of using solvent weld cement compositions is to apply them with a brush or cloth to the pipes to be joined. This involves the use of an open container of the composition at the work site. Whether laying plastic pipes in trenches or in buildings under construction, the conditions for using an open container of liquid are far from ideal in that there is little open room. In such environments, the pipe layer has no convenient location where an open solvent weld cement container can be placed. During the process of installing pipes in trenches, the solvent weld cement container typically is placed either in the trench or alongside the top of the trench. Since the container may be knocked or kicked over, there is risk of a resultant loss of solvent weld cement, contamination of the soil with hazardous substances, and attendant loss of time and productivity. Also, there is the risk of contamination of the solvent weld cement by dirt, debris, or water at the work-site, which can adversely affect the efficiency of the solvent weld cement.

[0007] There are additional problems associated with the use of existing liquid solvent weld cements which are applied to the plastic pipes to be joined by use of a brush or cloth, This mode of application is normally messy, especially in cramped areas. Also, this mode of application often does not result in the desired uniformity of coverage. Thus, this method may fail to provide an effective amount of cement in some areas while other areas may contain too much, causing possible failure of the joint, waste, and mess.

[0008] Another drawback associated with liquid solvent weld cements is that they typically do not allow the installer enough time to properly align the abutting plastic

pipes because the cement sets up in only three to five seconds and produces a weld that cannot be altered. Thus, it is desirable to have a solvent weld cement which can be applied to plastic pipe in such a manner that set-up time is extended to give the installer enough time to properly align the plastic pipe segments and be assured that the joint is proper.

[0009] Smrt et al, in Pat. No. 5,453,219, teaches an aerosol container containing a composition comprising an abrasive grit and a binder solution. The binder solution, which is suitable for affixing the grit onto a surface includes a polymeric resin, a solvent, and a liquid propellant. Upon being sprayed onto a surface, the solvent evaporates and the polymeric resin adheres the abrasive grit to the surface. The patent identifies the valve as being a standard SV-78 valve and the actuator as being a standard actuator.

[0010] It has been determined that in the spraying of paint, adhesives, and undercoatings from pressurized aerosol containers, the use of a male valve is inappropriate as male valves demonstrate a tendency to clog or plug, thereby rendering the aerosol container inoperative. The use of female valves for polymers has, until now, been limited to containers which are held upright. Such valves are less than ideal for the task of connecting plastic pipe as this task requires the sprayed composition to approach the pipe from all angles. Until now, an omnidirectional female valve has not been available to the art, and this has required physical gyrations by the user if anything other than surfaces easily sprayed by an upright container needed to be sprayed.

[0011] It can thus be seen that there exists a need for an aerosol composition having a solvent, a polymeric solvent weld cement material, and a propellant in a

pressurized aerosol container wherein the container can be used in any position, the contents do not clog the valve, and the contents do not erode the container.

SUMMARY OF THE INVENTION

[0012] This invention is directed to an aerosol solvent weld cement composition giving superior holding properties, a valve for improving the application of this composition onto plastic pipes, and a method of spraying the composition onto ends of plastic pipe segments during the fitting together of the segments.

[0013] The aerosol solvent weld cement composition of this invention consists essentially of (a) at least one polymer capable of welding plastic pipes to each other, (b) at least one organic solvent capable of dissolving the polymer, and (c) at least one propellant capable of dispensing the solvent and the polymer. The solvent weld cement composition of this invention is maintained under higher-than-ambient pressure in a sealed aerosol container. In a preferred embodiment, the aerosol container is equipped with a novel female valve which allows for omnidirectional spraying.

[0014] Additional ingredients may be added to the basic aerosol solvent weld cement composition of this invention as long as they do not materially affect the basic and novel character of the composition. These added ingredients include a dye, a suspending agent, and a stabilizer.

[0015] The present invention also includes a method of dispensing the aerosol solvent weld cement composition from the aerosol container using the omnidirectional female valve of this invention onto end portions of pipe segments to be joined.

[0016] This method comprises (a) obtaining an aerosol solvent weld cement composition consisting essentially of at least one polymer capable of welding plastic pipe

ends to each other, at least one organic solvent capable of dissolving the polymer, and at least one propellant capable of dispensing the polymer and organic solvent from a pressurized aerosol container, which container has an outlet and an omnidirectional female valve controlling flow through the outlet; (b) opening the valve of the container to dispense the aerosol composition onto ends of pipe segments to be joined, and (c) aligning and joining abutting pipe ends.

[0017] By using the composition and method of the present invention, contamination and waste of the solvent weld cement are avoided and a neat, uniform, application of solvent weld cement is made to the desired pipe surface resulting in a superior bond between the pieces of plastic pipe. Application of the cement according to the method of the present invention provides a longer set-up time than comparable brush application techniques, allowing for a better alignment and fit before the cement sets.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

[0018] Fig. 1 is a perspective view of a trench wherein an installer is laying water pipe by joining pipe segments according to the method of this invention.

[0019] Fig. 2 is a perspective view of an aerosol container in accordance with one embodiment of the present invention.

[0020] Fig. 3 is a cross-sectional view of an aerosol container used in the present invention.

[0021] Fig 4 is a side cross-sectional view of the omnidirectional valve of the present invention attached to a dip tube.

[0022] Fig. 5 is a cross-sectional plan view taken through the steel ball retainer of the omnidirectional valve of Fig. 4.

DETAILED DESCRIPTION OF THE INVENTION

[0023] The preferred embodiments will now be described with reference to the Figures. Like character numerals refer to like features throughout the description.

[0024] Plastic water pipe, **2** conventionally made from CPVC, PVC or ABS is typically laid in trenches 7 to 10 feet deep. In connecting the pipe segments, the installer joins a first segment **4** having a bell, or female, end **6** with a second segment **8** having a spigot, or male, end **10**. The spigot **10** of the second segment **8** is of a size which will allow it to snugly fit within the bell **6** of the first segment **4**.

[0025] When solvent weld cement is used in the joining process, the resulting seal is watertight. According to the present invention, the solvent weld cement is applied as an aerosol from an aerosol container **12** (Fig. 3) having an omnidirectional female valve **14** (Fig 4). The aerosol container **12** may be carried in a holster **16** which keeps the container **12** handy and avoids damage to, or loss of, the container **12**. The holster **16** can conveniently be made of leather, Nylon, or similar durable material and is provided with a clip **18** which enables the holster **16** to be clipped onto a belt or the top of the pants of the installer. The installer can withdraw the container **12** from the holster **16**, properly aim the container **12** so that spray will coat the desired portion of the pipe **2**, depress the actuating valve **20** thus releasing aerosolized solvent weld cement from the container **12** through the omnidirectional valve **14**, replace the container **12** into the holster **16**, and properly connect the two ends **6, 10** of the plastic pipe **2**.

[0026] Because the valve **14** is omnidirectional, the aerosol container **12** may be held at any angle and still produce a satisfactory spray pattern. The contents of the aerosol container **12** empty completely, thereby avoiding waste, and operate at

temperatures below 20°F. By using an aerosol composition rather than a liquid composition applied by brush or rag, the set-up time is increased to about eight to twelve seconds, allowing the installer additional time to correctly align the pipe segments **4, 8**.

[0027] The aerosol solvent weld cement composition of the present invention may be applied to a variety of plastic pipes in a wide array of applications. For instance, the compositions of the present invention can be applied in interior and exterior plumbing, in water supply pipes, communication pipes, drainage pipes, ventilation ducts, underground waste water systems, water supply systems, and irrigation systems.

[0028] The aerosol solvent weld cement composition of the present invention consists essentially of (a) at least one polymer adapted to weld plastic pipes to each other; (b) at least one organic solvent for the polymer; and (c) at least one propellant wherein the composition is under pressure greater than ambient atmospheric pressure. In the description of the composition of this invention, the term "consisting essentially of" is understood to have its well-recognized meaning in patent law. That is, it opens the definition of the composition only to the inclusion of unspecified ingredients which do not materially affect the basic and novel characteristics of the composition. Examples of ingredients which may be included as not materially affecting the basic and novel characteristics of the composition are suspending agents, dyes, and stabilizers.

[0029] The polymer of the composition may be any polymer or mixture of polymers appropriate for welding the plastic pipe segments to each other. The polymer may be at least one of chloropolyvinylchloride, polyvinylchloride, acrylonitrile-butadiene styrene polymers, polymers of lower alkyl esters of butyric acid, and polymers of lower alkyl esters of acrylic acid. The polymer component is preferably present in the range of

about 10%-30% by weight of the total composition. Chloropolyvinylchloride polymers in the concentration of 10% by weight of the total composition constitute the most preferred embodiment.

[0030] When chloropolyvinylchloride is the polymer, a stabilizer in the solvent system is required in order to prevent the degradation of chloropolyvinylchloride. If the stabilizer is absent, the polymer may pre-polymerize such that it gels. Also, the polymer degrades to become more aggressive such that it may corrode the interior of the container, thereby contaminating the solvent weld cement composition. A stabilizer must be selected which can preclude the degradation of the chloropolyvinylchloride. Such stabilizers are known in the art. The stabilizer is preferably present in an amount up to 1% by weight of the solvent weld cement composition.

[0031] The solvent system of the composition may be any appropriate organic solvent which can solubilize the polymer being used. Examples of suitable solvents are tetrahydrofuran, acetone, diethoxyethane, N-methyl pyrrolidone, dibasic esters, alkylene carbonates, dimethyl formamide, ethyl acetate, methyl isobutyl ketone, methyl alcohol, cyclohexanone, methyl ethyl ketone, gamma-butyrolactone, and mixtures thereof.

[0032] The solvent system is preferably present in an amount within the range of from about 50% to about 80% by weight of the aerosol solvent weld cement composition. For welding PVC pipe, it is preferred that the solvent system will be a mixture of about 30-50% by weight tetrahydrofuran, about 20-40% by weight acetone, about 10-20% by weight cyclohexanone, and about 5-15% by weight gamma-butyrolactone. More preferably, the solvent system is a mixture of about 40% by weight tetrahydrofuran,

about 20% by weight acetone, about 15% by weight cyclohexanone, and about 10% by weight gamma-butyrolactone.

[0033] The propellant may be one of the conventional aerosol propellants. Examples of such propellants are dimethyl ether, isobutane, n-butane, propane, nitrogen, carbon dioxide, 1-difluoroethane, tetrafluoroethane, and mixtures of any two or more of these. When the pipe to be joined is made of PVC, it is preferred that the propellant be dimethyl ether. The propellant is preferably present in an amount of between about 20% by weight to about 35% by weight and most preferably, 30% by weight, of the aerosol solvent weld cement composition.

[0034] The aerosol solvent weld cement composition may also contain a suspending agent to improve the viscosity of the composition. The suspending agent may be any of those known in the art. Amorphous silica is preferred. The amount of the suspending agent is preferably 1-5% by weight of the solvent weld cement composition.

[0035] The aerosol solvent weld cement composition may additionally contain a dye for purposes of providing visibility to the composition when it is applied to a pipe. The dye should be oil soluble. Sufficient dye should be used to impart a color to the solvent weld cement composition when it is sprayed onto a pipe. Purple dyes are preferred. By incorporating a dye, a uniform distribution of the composition may be assured.

[0036] The aerosol solvent weld cement composition of this invention may be formulated and packaged using methods known in the art. The aerosol container **12** contains the aerosol solvent weld cement composition under pressure which is greater than ambient pressure and is sufficient to cause the solvent weld cement to issue as a

spray when the actuating valve **20** is actuated. Preferably, the pressure within the container **12** is greater than 40 psi gage. More preferably, the pressure is 62 psi gage. The actuating valve **20** may have a standard or tapered orifice **22**, although a wide open actuator **20** is preferred. The container **12** has an actuating valve **20** sealed to the container **12** by an elastomeric gasket **24**. The container **12** may be lined or unlined. In order to provide omnidirectional characteristics to the aerosol container **12**, a particular omnidirectional female aerosol valve **14** is used in combination with the composition of this invention.

[0037] The following example provides a preferred embodiment of the solvent weld cement composition according to this invention. All percentages are by weight of the total composition.

[0038] EXAMPLE

CPVC polymer	2-30%
dimethyl ether	20-50%
Solvent system	50-80%
tetrahydrofuran	0-50%
acetone	0-40%
cyclohexanone	0-25%
butyrolactone	0-20%
amorphous silica	1-5%
oil-soluble dye	0-1%
stabilizer	0-1%

[0039] The present invention encompasses the above-described aerosol solvent weld cement composition in a pressurized aerosol container **12** wherein a novel omnidirectional female valve **14** allows the container **12** to be positioned in any direction and permit a uniform spray pattern of the composition without clogging the valve **14**.

[0040] The container **12** comprises an outlet **22**, an unrestricted actuator **20**, and a female omnidirectional valve **14** to permit a controlled release of the composition while the container **12** is in any position. The valve **14** is preferably sealed to the container **12** by an elastomeric gasket **24**. The size of the container **12** is not critical, but should be conveniently handled by an installer. The container **12** may be tin plated, epoxy-lined steel, or epoxy-lined aluminum.

[0041] It has been determined that in the spraying of polymers from pressurized aerosol containers, the use of a male valve is inappropriate as male valves demonstrate a tendency to clog or plug, thereby rendering the aerosol container inoperative. The use of female valves for polymers has, until now, been limited to containers which are held upright. Such valves are less than ideal for the task of connecting plastic pipe as this task requires the aerosol container to be usable in the inverted position in tight quarters. Until now, an omnidirectional female valve has not been available to the art, and this has required physical gyrations by the user if anything other than surfaces easily sprayed by an upright container needed to be sprayed.

[0042] Part of the present invention is an omnidirectional female valve **14** for use as the valve in the pressurized container **12**, which contains a dip tube **26**, which container **12** will be inverted during use. This valve **14** may be more readily understood

with reference to Figs. 4 and 5. Reference is also made to Fig. 3 for features of the container **12** not shown in Figs 4 and 5.

[0043] The novel valve **14** comprises a valve body **28**, a valve seal **24**, an actuator **20**, a valve plunger **30**, a compression spring **32**, and an omnidirectional attachment **34**.

[0044] The valve body **28** is constructed of suitable thermoplastic resins or Nylon and is generally cup-shaped. The valve body **28** has a thickened top rim **36** surrounded by castellations. The valve body **28** further contains a lower end **38** having a central intake opening **40**, an exterior surface **42**, an interior cup-shaped opening **44**, an internal passageway **46** extending from the lower end **38** to the cup-shaped opening **44**, an internal shoulder **48**, an external shoulder **50**, and an exterior ridge **52**.

[0045] The valve seal **24**, preferably made of rubber, fits across the top rim **36** of the valve body **28** and is held between the valve body **28** and the interior surface **54** of a modified cup **56** by crimping around the castellations of the valve body **28**. The valve seal **24** assures a permanent tight fit between the interior surface **54** of the cup **56** and the top rim **36** of the valve body **28**. The cup **56** is of such a size as to fit the standard one-inch (2.54 cm) hole in aerosol containers **12**.

[0046] The actuator **20** is located above the valve body **28** and mounts on the valve plunger **30**. The actuator **20** contains an outlet orifice **22** and a vertical stem **58** having inner **60** and outer **62** surfaces, an inlet orifice (not shown) commonly in the form of a slit between the inner **60** and outer **62** surfaces of the stem **58**, a lower end **64**, and a passageway **66** for the viscous material.

[0047] The valve plunger **30** contains an open cup **68** having an upper surface **70** for holding the lower end **64** of the actuator **20**, a closed bottom **72** which fits inside the compression spring **32**, and a lower shoulder **74** for abutting with the compression spring **32**. The valve plunger **30** is slidably held in the cup-shaped opening **70** of the valve body **28**.

[0048] The compression spring **32** has an upper end which abuts with the lower shoulder **74** of the valve plunger **30** and a lower end which abuts with the internal shoulder **48** of the valve body **28**. When there is no downward pressure on the actuator **20**, the spring **32** tends to force the valve plunger **30** upwardly against the valve seal **24**, thus preventing escape of the contents from the container **12**. When there is a downward pressure on the actuator **20**, the valve plunger **30** is forced downwardly and a space develops between the valve seal **24** and the upper surface **70** of the valve plunger cup **68**, and the contents of the container **12** are allowed to escape through the inlet orifice (not shown) into the stem **58** of the actuator **20**.

[0049] The omnidirectional attachment **34** contains a top **76** which abuts against the external shoulder **50** of the valve body **28**, side walls **78** having exterior **80** and interior **82** surfaces, the side walls **78** having a notch **84** on the interior surface **82**, a hollow lower stem **86** having a lower end **88**, and a check valve container **90**.

[0050] The lower stem **86** fits into a dip tube **26** which extends from the lower stem **86** to the bottom **92** of the container **12**. The lower stem **86** contains a lower vertical passageway **94** and lateral passageway **96** through which the viscous material passes when the container **12** is in the upright position. The lateral passageway **96** leads

from the upper end **98** of the lower passageway **94** in the lower stem **86** to the central intake opening **40** of the valve body **28**.

[0051] The top **76** of the omnidirectional attachment **34** is held permanently in place to the valve body **28** by a snap-on connection between the external ridge **52** of the valve body **28** and the notch **84** on the interior surface **82** of the side wall **78** of the omnidirectional attachment **34**.

[0052] The check valve container **90** contains an open, but constricted, lower end **100** joining the lateral passageway **96**, a top surface **102**, a lateral opening **104**, and a check ball **106**.

[0053] The operation of the omnidirectional valve **14** will now be described with reference to Fig. 4. In this description, the term "upright position" refers to any position of the container **12** which allows the check ball **106** to close the constricted lower end **100** of the check valve container **90**, the term "inverted position" refers to any position which allows the check ball **106** of the check valve container **90** to open the constricted lower end **100** of the check valve container **90** and allow passage of viscous material through the lateral opening **104** into the lateral passageway **96**, the term "upper end **108** of the container **12**" refers to that end closest to the actuator **20**, and the term "lower end **92** of the container **12**" refers to that end farthest from the actuator **20**.

[0054] When the container **12** is in the upright position or the inverted position, and the actuator **20** is not depressed, no solvent weld cement material will flow from the container **12** through the actuator **20**.

[0055] When the container **12** is in the, upright position, the solvent weld cement material inside the container **12** is at the lower end **92** of the container **12** and the

pressurizing gas is in the upper end **108** of the container **12**. If the actuator **20** is depressed, the solvent weld cement material is forced up the dip tube **26**, into the lower passageway **66** in the stem **86** of the omnidirectional valve attachment **34**, through the lateral passageway **94**, through the internal passageway **46** of the valve body **28**, around the valve plunger **30**, through the inlet orifice (not shown) of the actuator **20**, through the passageway **66** of the stem **58** of the actuator **20**, and out the outlet orifice **22** of the actuator **20**. In this case, neither the solvent weld cement material nor the propellant enters the check valve container **90** as the check ball **106** seals off the constricted lower end **100** thereof.

[0056] When the container **12** is in the inverted position, the solvent weld cement material inside the container **12** is at the upper end **108** of the container **12** and the pressurizing gas is in the lower end **92** of the container **12**. In this position, the check ball **106** (shown dashed) lies against the top surface **102** of the check valve container **90** allowing flow of solvent weld cement material from the upper end **108** of the container **12** into the lateral passageway **96** of the omnidirectional attachment **34**. If the actuator **20** is depressed, the solvent weld cement material is forced by the pressurizing gas through the lateral opening **104** into the check valve container **90**, past the check ball **106**, through the lateral passageway **96**, through the internal passageway **46** of the valve body **28**, around the valve plunger **30**, through the inlet orifice (not shown) of the actuator **20**, through the passageway **66** of the actuator **20**, and out the outlet orifice **22** of the actuator **20**. In this case, the pressurizing gas does not enter the internal passageway **46** of the valve body **28** as the solvent weld cement material seals off the lateral passageway **96**.

[0057] The present invention also includes a method of dispensing an aerosol solvent weld cement from a pressurized aerosol container **12**. The method comprises the steps of (a) obtaining a solvent weld cement composition as described above in an aerosol container **12** containing an omnidirectional valve **14** as described above at a pressure greater than ambient atmospheric pressure and (b) opening the omnidirectional valve **14** of the container **12** so as to cause the pressurized aerosol solvent weld cement composition to be released from the container **12**.

[0058] Another aspect of the present invention is a method of welding two sections **4, 8** of plastic pipe **2** at a junction by using the above-described aerosol solvent weld cement composition. This method comprises (a) obtaining a solvent weld cement composition as described above in an aerosol container **12** containing an omnidirectional valve **14** as described above at a pressure greater than ambient atmospheric pressure, (b) opening the omnidirectional valve **14** of the container **12** so as to cause the pressurized aerosol solvent weld cement composition to be released from the container **12** onto at least one of the two sections **4, 8** of plastic pipe **2** at the prospective location of the junction; and (c) adjoining the two sections **4, 8** of plastic pipe **2** so as to form the junction by welding action.

[0059] Although the invention has been described and illustrated in detail, it is to be clearly understood that the same is by way of illustration and example, and is not to be taken by way of limitation. The spirit and scope of the present invention are to be limited only by the terms of the appended claims.